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The relationship between the fractional integral and the fractal structure of a memory set [1]

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Abstract

It is shown that there is no direct relation between the fractional exponent v of the fractional integral and the fractal structure of the memory set considered, v depends only on the first contraction coefficient ξ_1 and the first weight P_1 of the self-similar measure (or infinite self-similar measure) μ on the memory set. If and only if $P_1 = \xi_1^{\beta}$ (where $\beta \in (0,1)$ is the fractal dimension of the memory set), v is equal to the fractal dimension of the memory set. It is also true that v is continuous about ξ_1 and P_1.

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Keywords: Flûx; Memory measure; Laplace transform; Memory set; Self-similar (or infinite self-similar) measure

1. Introduction

When we describe the structure of evolution of a physical system far from thermodynamic equilibrium, e.g., in amorphous materials [1–3], in the description of structural relaxation of high-T_c oxide superconductors [4], in the process of plastic deformation [5], fracture of solids [6], in the description of solid solutions [7], the macrostructure of martensite [8], and so on, it has been found that the medium exhibits memory. The existence of memory means that if at time τ a force $f(\tau)$ acts on the system, then there

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